Mechanical and Fluid Systems

Fluid Structure Coupling Technology

Passive method controls coupling between fluids and structures to disrupt and/or control the dynamics of a structure

NASA's Marshall Space Flight Center's Fluid Structure Coupling (FSC) technology is a highly efficient and passive method to control the way fluids and structures communicate and dictate the behavior of a system. Developed to solve a difficult structural dynamics issue of a national asset, an FSC device weighing less than 200 lbs successfully mitigated a potentially detrimental resonant response of this 650,000 lb structure. This technology has the demonstrated potential to mitigate a multitude of different types of vibration issues and can be applied anywhere where internal or external fluids interact with physical structures. For example, in a multistory building, water from a rooftop tank or swimming pool could be used to mitigate seismic or wind-induced vibration by simply adding an FSC device that controls the way the building engages the water.

BENEFITS

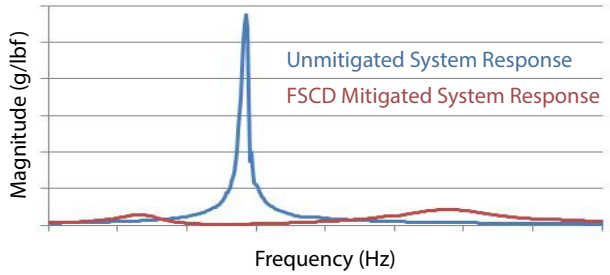
- Passive device
- Minimized size and weight, since FSC devices can leverage existing fluids in and around the system
- Inexpensive: easy to retrofit to existing fluid systems
- Reduced complexity as control is achieved with a single fluid source
- Highly efficient, achieving complete control of the phase lag between fluid and structure

technology solution

THE TECHNOLOGY

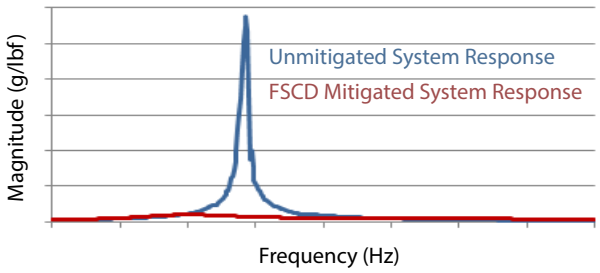
FSC is a passive technology that can operate in different modes to control vibration:

1. **Harmonic absorber mode:** The fluid can be leveraged to act like a classic harmonic absorber to control low-frequency vibrations. This mode leverages already existing system mass to decouple a structural resonance from a discrete frequency forcing function or provide a highly damped "dead zone" for responses across a frequency range.



Example of vibration mitigation in a harmonic absorber application

2. **Shell mode**: The FSC device can couple itself into the shell mode and act as an additional spring in series, making the entire system appear dynamically softer and reducing the frequency of the shell mode. This ability to control the mode without having to make changes to the primary structure enables the primary structure to retain its load-carrying capability.
3. **Tuned mass damper mode:** A small modification to a geometric feature allows the device to act like an optimized, classic tuned mass damper, enabling the primary structure to take on the damping characteristics of the FSC device.



Example of vibration mitigation in a tuned mass damper application

APPLICATIONS

The technology has several potential applications:

Structural – Multistory buildings, stacks, towers, bridges, pools for spent nuclear fuel

Oil & Gas – Oil & Gas: Offshore oil rigs, above-ground storage tanks

Municipal – Water tanks/towers

Aviation – Control of vibration transmission from wet wings and fuel sloshing

Marine – Multi directional stabilization of vessels or platforms

PUBLICATIONS

U.S. Provisional Patent Application Chronology No. CN_3193

More Information

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NP-2014-08-1165-HQ

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MFS 32903-1